

## **APPENDIX A**

### **Amendments made to paragraphs at page 16, lines 8-31, and page 17, lines 1-11:**

Echo cancellation is accomplished with an adaptive cancelling filter [84] 85 as shown in the block diagram of FIG. 12. Each echo canceller 40 receives the TXData symbols 36 from the transmitter at the same end of the twisted wire pair 18 as that of the receiver with which the echo canceller is associated. As shown in FIG. 9, each echo canceller 40 includes one filter [84] 85. These filters [84] 85 model the impulse responses of the echo noise from the transmitter and may be implemented as ATFs employing, for example, the LMS algorithm. The filter produces a replica of the echo impairment signal contained within the combination signal received by the receiver with which the echo canceller 40 is associated. The replica echo impairment signal 90 is introduced into the second device 50 (FIG. 9) where it is combined with the combination signal 48 to produce the first soft decision signal 52 which is substantially devoid of echo impairment signals.

FEXT cancellation is accomplished with three adaptive FEXT cancelling filters [84] 87 as shown in the block diagram of FIG. 13. Each FEXT cancellation system 70 receives three tentative decision symbols 74 one from each of the receivers at the same end of the communications line as the receiver with which the FEXT cancellation system is associated. Each FEXT cancellation system 70 includes three filters [84] 87, one for each of the tentative decision symbols 74. These filters [84] 87 model the impulse responses of the FEXT noise from transmitters and may be implemented as ATFs employing, for example, the LMS algorithm. The filters [84] 87 produce a replica of the FEXT impairment signal 96 for each individual tentative decision symbol 74. A summing device 108 combines the three individual replica FEXT impairment signals 96 to produce a replica of the FEXT impairment signal contained within the combination signal 48 received by the receiver with which the FEXT cancellation system is associated. The replica FEXT impairment signal 94 is introduced into the first device 56 (FIG. 9) where it is combined with the second combination signal 66 to produce the third soft decision signal 68 which is substantially devoid of FEXT impairment signals. It is important to note that the higher error rate of the tentative decisions 74 does not degrade the performance of the FEXT

cancellation system 70, because the decisions used to cancel FEXT are statistically independent from the final decisions 72 made by the receiver whose FEXT is being canceled. Details of a FEXT cancellation system are disclosed in copending patent application S/N 09/037,328, filed March 9, 1998, entitled APPARATUS FOR, AND METHOD OF, REDUCING NOISE IN A COMMUNICATIONS SYSTEM, inventor Oscar E. Agazzi and assigned of record to the assignee of record of this application.

**Amendments made to paragraph at page 17, lines 23-31 and page 18, lines 1-20:**

As previously mentioned, the NEXT cancellation system, echo canceller and FEXT cancellation system use ATFs to effectively cancel the noise from the combination signal. An example of an ATF which may be employed by the present invention is shown in FIG. 14 and is further disclosed in copending patent application S/N 60/107,877, filed November 9, 1998 entitled DIRECT-TRANPOSED FILTER, inventor Mehdi Hatamian and assigned of record to the assignee of record of this application. The ATF 120 includes a plurality of taps 122 each including a multiplier 124 and an adder 126. Associated with each tap 122 is a coefficient  $C_n$ , where  $n$  is 0 [though] through  $x-1$  where  $x$  is the number of taps in the ATF. The circuitry associated with each tap 122 includes a 1-bit storage (not shown) that allows for activation and deactivation of the tap. The values of the coefficients  $C_n$  are adjusted in accordance with an LMS algorithm as mentioned before. Interposed between the taps 122 are registers 128. These registers 128 provide data to the taps 122 at timed intervals in accordance with a clock signal. A suitable register 128 for use in the present invention is disclosed in copending patent application S/N 60/107,878, filed November 9, 1998, entitled STATIC-DYNAMIC REGISTER, inventor Mehdi Hatamian and assigned of record to the assignee of record of this application.

The impulse responses of an echo and NEXT, as shown in FIGS. 7 and 8, indicates that not all taps 122 in the NEXT and echo cancellers 38, 40 are contributing significantly to the performance of the communications system. The present invention determines what taps 122 are not contributing significantly to the reduction of the mean squared error (MSE) of the system and deactivates these taps, thereby eliminating them from the filtering computation and thus reducing

considerably the power dissipation of the system. Furthermore, as shown by the impulse response of FIGS. 7 and 8, the need to build NEXT and echo cancellers 38, 40 with a long span is difficult to avoid. Specific cable responses may differ from the one depicted in FIGS. 7 and 8, and accordingly require more or fewer taps 122 [then] than that required for the cable of FIGS. 7 and 8. As mentioned before it is difficult to determine a priori what taps 122 are needed with a particular cable.

**Amendments made to the paragraph at page 21, lines 4-9:**

For the case of the 24 dB threshold, out of 440 initially active taps, only 30 remain active after the application of the tap scanning algorithm, while maintaining a 5dB margin for required bit error rate. Notice from FIGS. [16] 17 and [17] 18 that those taps 122 which remain active occur at sparse locations, and it would have been difficult to statically allocate these taps during the design of the NEXT and echo cancellers, because the location of taps is highly dependent on the specific cable response.